



# The NASA Applied Remote Sensing Training (ARSET) Program User Engagement and Best Practices

Melanie Follette-Cook

AOS Applications Seminar

November 17, 2022





# NASA Applied Remote Sensing Training (ARSET)

<https://appliedsciences.nasa.gov/arset>

The ARSET Program delivers cost-free training on the use of Earth Observations for decision making

- Our trainings are:
  - Online and in-person
  - Live, instructor-led, or self-guided
  - Provided at no cost, with materials and recordings available from our website
  - Often multi-lingual
  - Range in level from **introductory** to **advanced**



EARTH SCIENCE  
APPLIED SCIENCES



CAPACITY  
BUILDING

## ARSET Training Themes

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Disasters



Agriculture



Land



Water Resources



Climate



Health & Air Quality

# ARSET Trainings 2009 - 2022



179 trainings



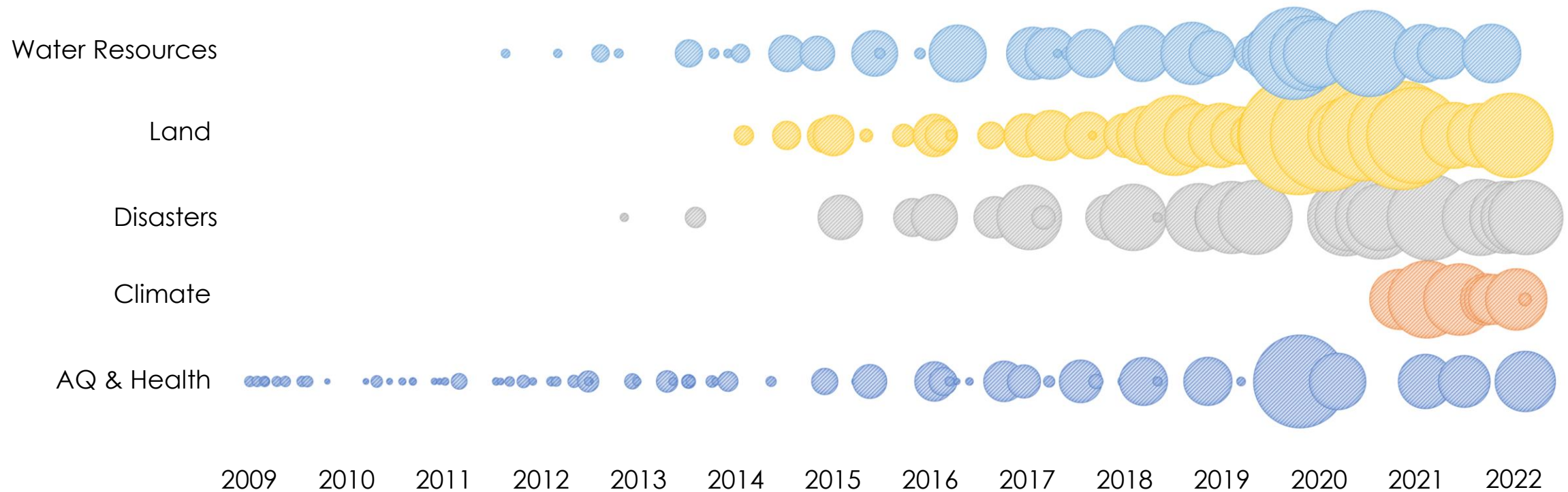
95,000+ participants



182 countries



17,000+ organizations



# ARSET Team Members



**Melanie Follette-Cook**  
Project Scientist,  
Instructor



**Brock Blevins**  
Training Coordinator



**David Barbato**  
Spanish Translator



**Sean McCartney**  
Instructor



**Amita Mehta**  
Lead Instructor



**Erika Podest**  
Lead Instructor



**Annelise Carleton-Hug**  
Program Evaluator



**Sarah Cutshall**  
Associate Outreach  
Coordinator



**Natasha Johnson-Griffin**  
Training Coordinator



**Amber McCullum**  
Lead Instructor



**Juan Torres-Pérez**  
Instructor



**Britnay Beaudry**  
Instructor



**Selwyn Hudson-Odoi**  
Training Coordinator



**Marines Martins**  
Project Support



**Jonathan O'Brien**  
Technical Writer/Editor



**Pawan Gupta**  
Lead Instructor



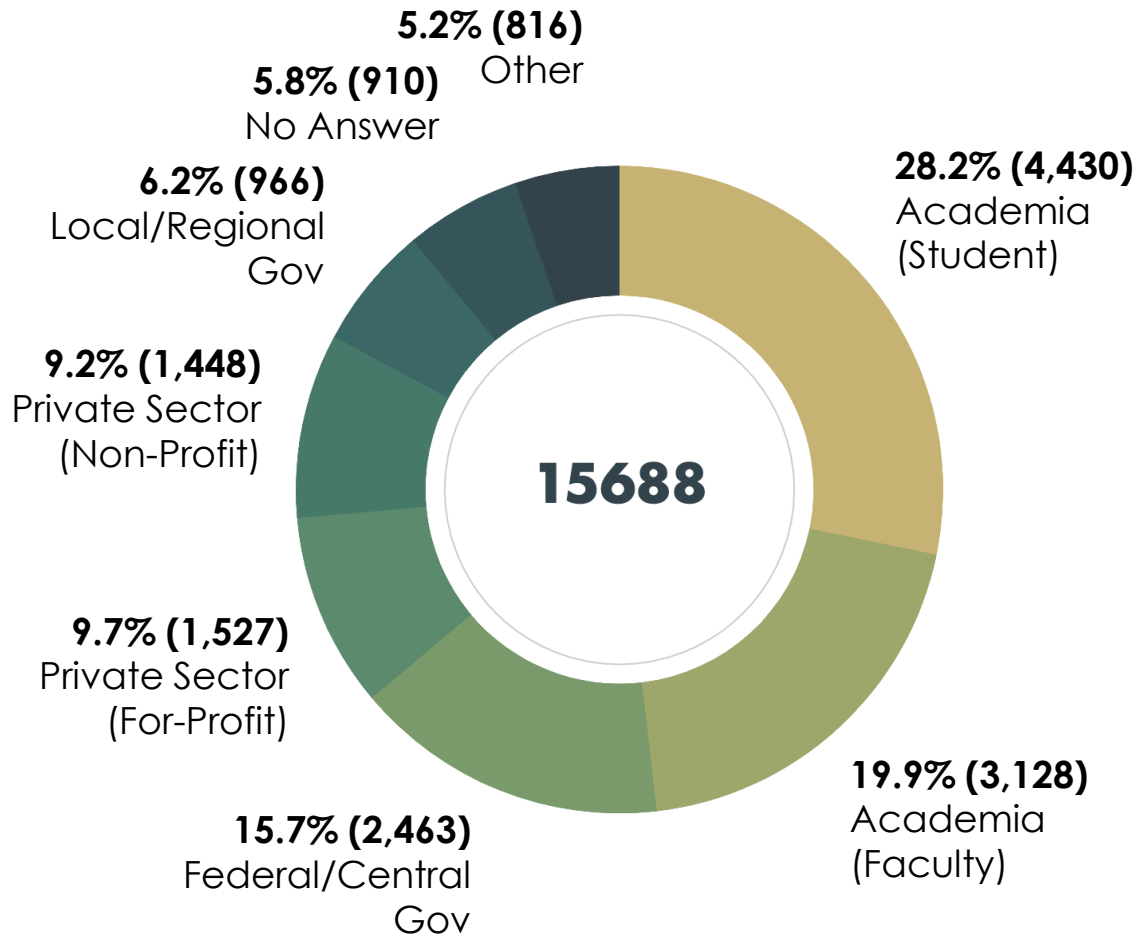
**Carl Malings**  
Instructor



**Sarah Strode**  
Instructor

# ARSET trainings serve a diverse set of communities...

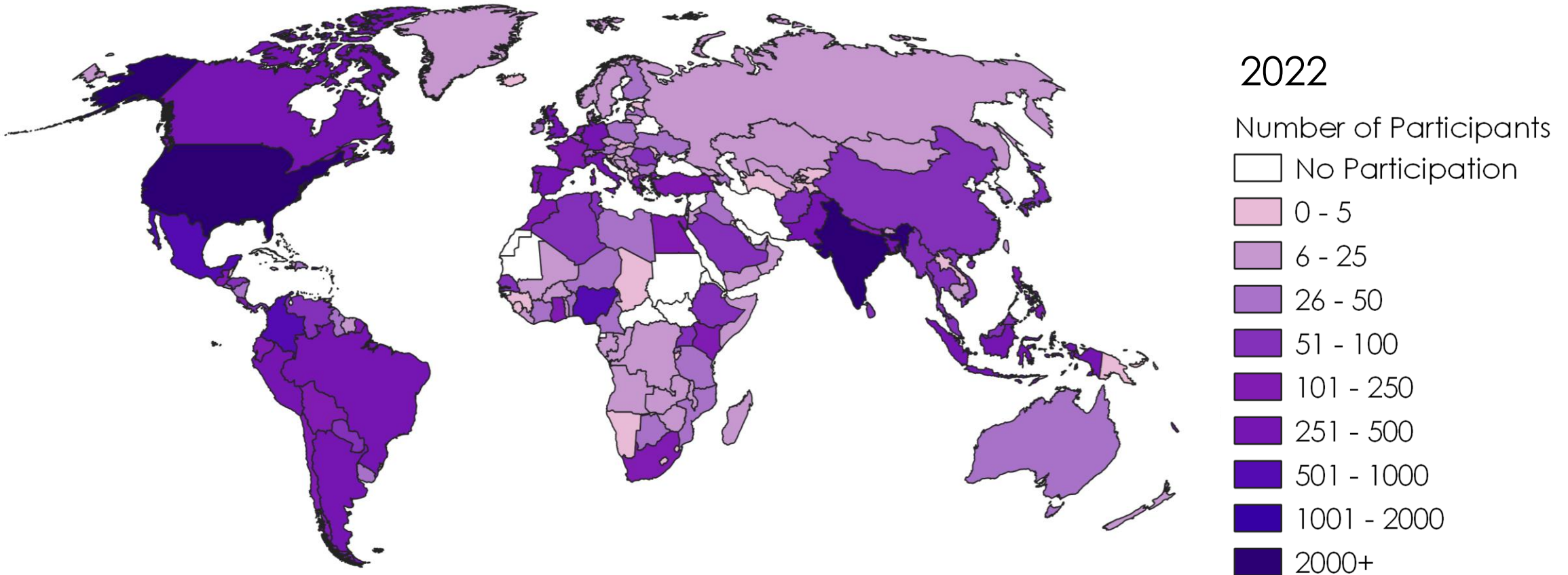
## Participation by Sector



- ARSET trainings are intended for policymakers, NGOs, and other applied science professionals looking to incorporate NASA remote sensing into their daily, operational activities.
- ARSET also trains the next generation of Earth scientists.
  - Academia (both faculty and students) routinely make up 40-60% of training attendees.



# Across multiple continents

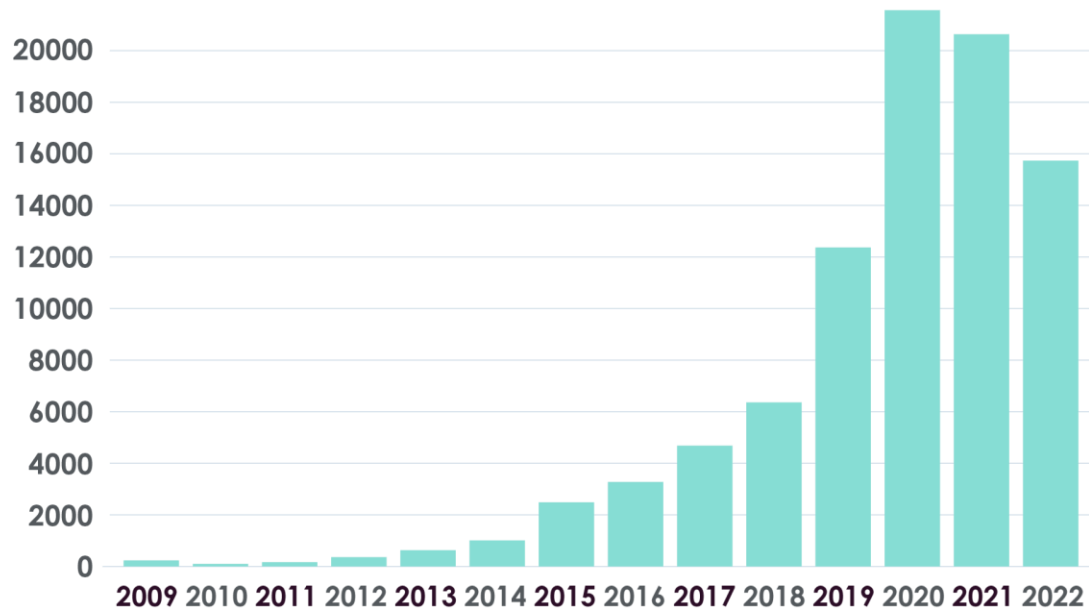


- 80% of attendance is international
- Highest participation outside US is India, Colombia, and Mexico

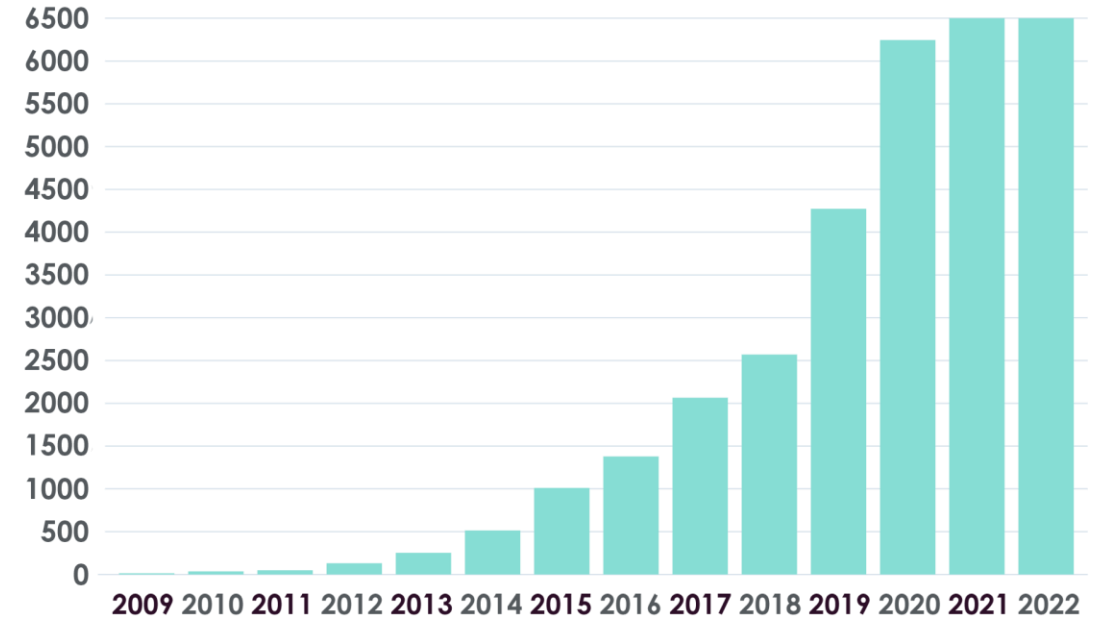


# ARSET continues to grow and reach new communities each year.

## Participation by Year



## Unique Organizations



# Sample 2022 ARSET Trainings



Selecting Climate Change  
Projection Sets for Mitigation,  
Adaptation, and Risk  
Management Applications



Disaster Assessment Using  
Synthetic Aperture Radar  
*En Español*



Applications of Remote Sensing-  
Based Evapotranspiration Data  
Products for Agricultural and  
Water Resource Management



Accessing and Analyzing Air  
Quality Data from  
Geostationary Satellites



Evaluating Ecosystem  
Services with Remote Sensing

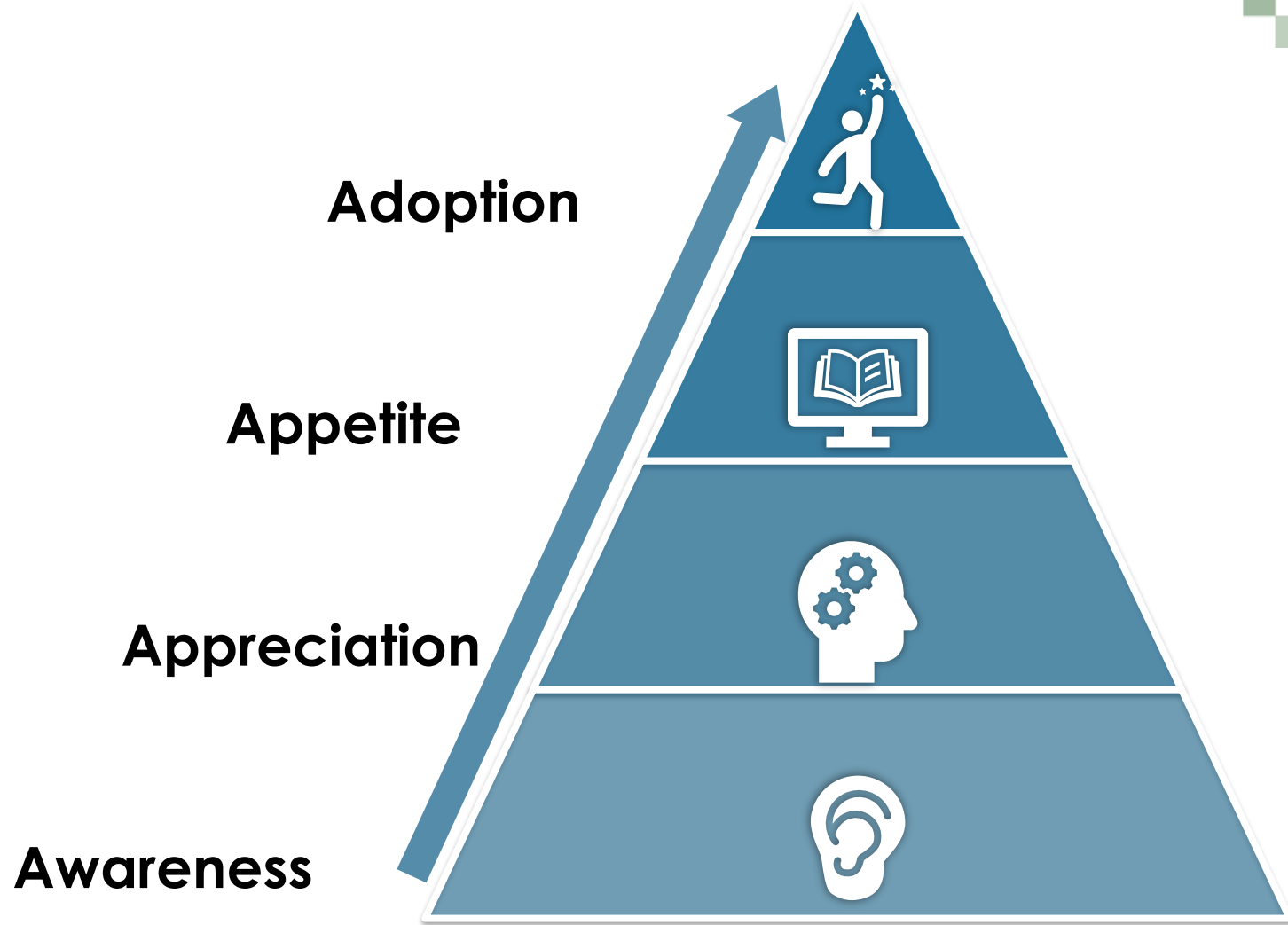


Mapping Crops and their  
Biophysical Characteristics with  
Polarimetric SAR and Optical  
Remote Sensing *En Español*



# Why training?

- Accelerate use of data from awareness, appreciation, appetite, through adoption
- Improve utility of data products and tools for users
- Communicate appropriate uses of data products
- Increasing use of data in user communities enables more informed decisions



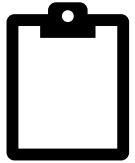
# Building an Effective Training

1. Assess End-User Needs
2. Define and design the training
3. Training Promotion
4. Develop Training Material
5. Conduct the Training
6. Evaluate the Training



# Assess End-User Needs

For a training to be effective, trainers need to understand the needs of participants



Survey responses



Interviews



EARTH SCIENCE  
APPLIED SCIENCES

NASA-developed  
resources and tools



Conferences and Meetings



# Define and Design the Training

## 1. Define training motivation and learning objectives

- Purpose: What knowledge/skills will be gained?
- Audience: Who the training will target
- Impact: Value/Use of the training by the audience

## 2. Design and outline training

- Determine training level (e.g., introductory vs. advanced)
- Assess need for additional subject matter expertise
- Consider offering at least two sessions to capture multiple time zones
- Consider number and length of parts
- Investigate potential case studies



# Training Promotion

Identify appropriate organizations, sectors, or regions for participation in your training activity

ARSET promotes trainings to the following:

- Applied science professionals and decision-makers
- Organizations with demonstrated environmental need
- Previously unreached organizations
- A sector or geographic region with low engagement
- Organizations with potential for future collaboration
- Stakeholders with unique knowledge of their community's decision support system

Promotion through

- Listserv
- Existing portals, groups
- Networking
- Social Media

**Linked in**

 **reddit**

**twitter** 



# Develop Training Material

## Lectures

**What are Ecosystem Services?**

- Ecosystem services are the benefits people obtain from ecosystems.
- There is a wide range of conditions and processes through which natural ecosystems, and the species that are part of them, help sustain and fulfill human life.



Image Credit: iStock | Image Credit: Uppilsh | Image Credit: Science.com

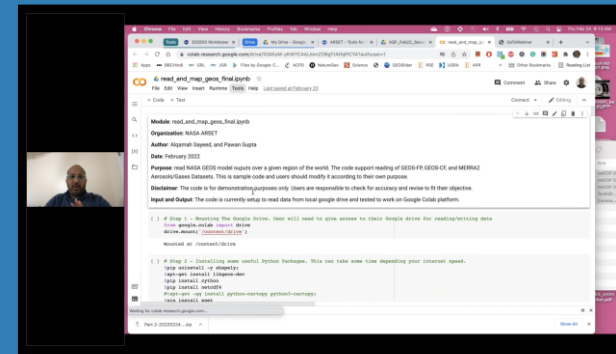
NASA's Applied Remote Sensing Training Program

## Demonstrations



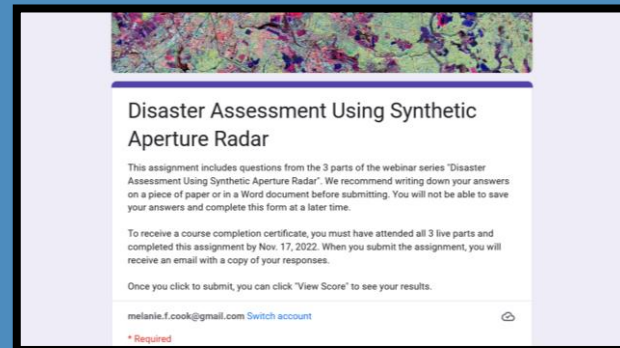
WorldView interface showing a map of the Amazon region with a flood overlay.

## Hands-on Exercises



Google Colab notebook showing code for processing satellite data.

## Homework



**Disaster Assessment Using Synthetic Aperture Radar**

This assignment includes questions from the 3 parts of the webinar series "Disaster Assessment Using Synthetic Aperture Radar". We recommend writing down your answers on a piece of paper or in a Word document before submitting. You will not be able to save your answers and complete this form at a later time.

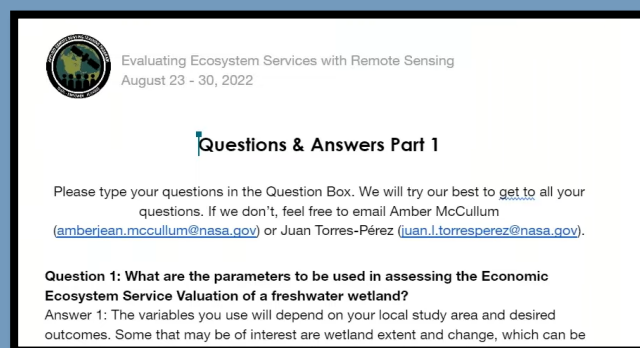
To receive a course completion certificate, you must have attended all 3 live parts and completed this assignment by Nov. 17, 2022. When you submit the assignment, you will receive an email with a copy of your responses.

Once you click to submit, you can click "View Score" to see your results.

melanie.f.cook@gmail.com [Switch account](#)

\* Required

## Q&A



**Evaluating Ecosystem Services with Remote Sensing**  
August 23 - 30, 2022

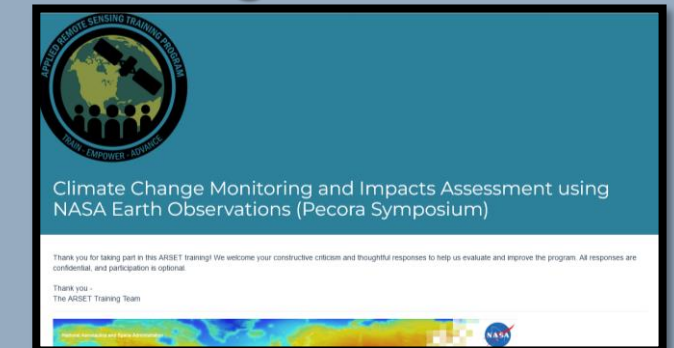
**Questions & Answers Part 1**

Please type your questions in the Question Box. We will try our best to get to all your questions. If we don't, feel free to email Amber McCullum ([amberjean.mccullum@nasa.gov](mailto:amberjean.mccullum@nasa.gov)) or Juan Torres-Pérez ([juan.l.torresperez@nasa.gov](mailto:juan.l.torresperez@nasa.gov)).

**Question 1: What are the parameters to be used in assessing the Economic Ecosystem Service Valuation of a freshwater wetland?**

Answer 1: The variables you use will depend on your local study area and desired outcomes. Some that may be of interest are wetland extent and change, which can be

## Training Evaluation



**Climate Change Monitoring and Impacts Assessment using NASA Earth Observations (Pecora Symposium)**

Thank you for taking part in this ASSET training! We welcome your constructive criticism and thoughtful responses to help us evaluate and improve the program. All responses are confidential, and participation is optional.

Thank you,  
The ASSET Training Team



# Training Evaluation

Training evaluation is important for assessing success in meeting learning objectives, assessing training impact, and identifying future training topics and other areas for improvement.

## Exit Survey

- Gather immediate impressions
- Determine if learning objectives were met
- Gather future training topics

## Post Training Survey

- Sent one year after training
- Assess changes in use of remote sensing observations and tools
- Identify barriers to adoption

## Interviews

- Gain deeper insights into training benefits



# Sample Training Timeline

**4-6 months prior**

**3 months prior**

**2 months prior**

**1 month prior**

- Develop preliminary agenda
- Begin outreach
- Identify parts & case studies

- Finalize agenda
- Continue outreach
- Develop training content

- Begin registration
- Create webpage

- Complete training materials
- Begin translation
- Develop homework

**2 weeks prior**

**Day after session**

**Last day of last training**

**One year after training**

- Finish translation
- Finalize training materials
- Send training event reminders

- Post webinar recording online

- Distribute the first survey
- Update website
- Send survey reminder 2 wks later

- send second survey or impact assessment





# Advice for AOS

- Consider using training to develop capacity in your user communities.
- Begin with user needs first and work from there.
- Accommodate different experience levels of future data users.
- Invest in making your products analysis-ready (e.g., provide readers or code to cut down on initial processing).





**Thank you!**





**WMO OMM**

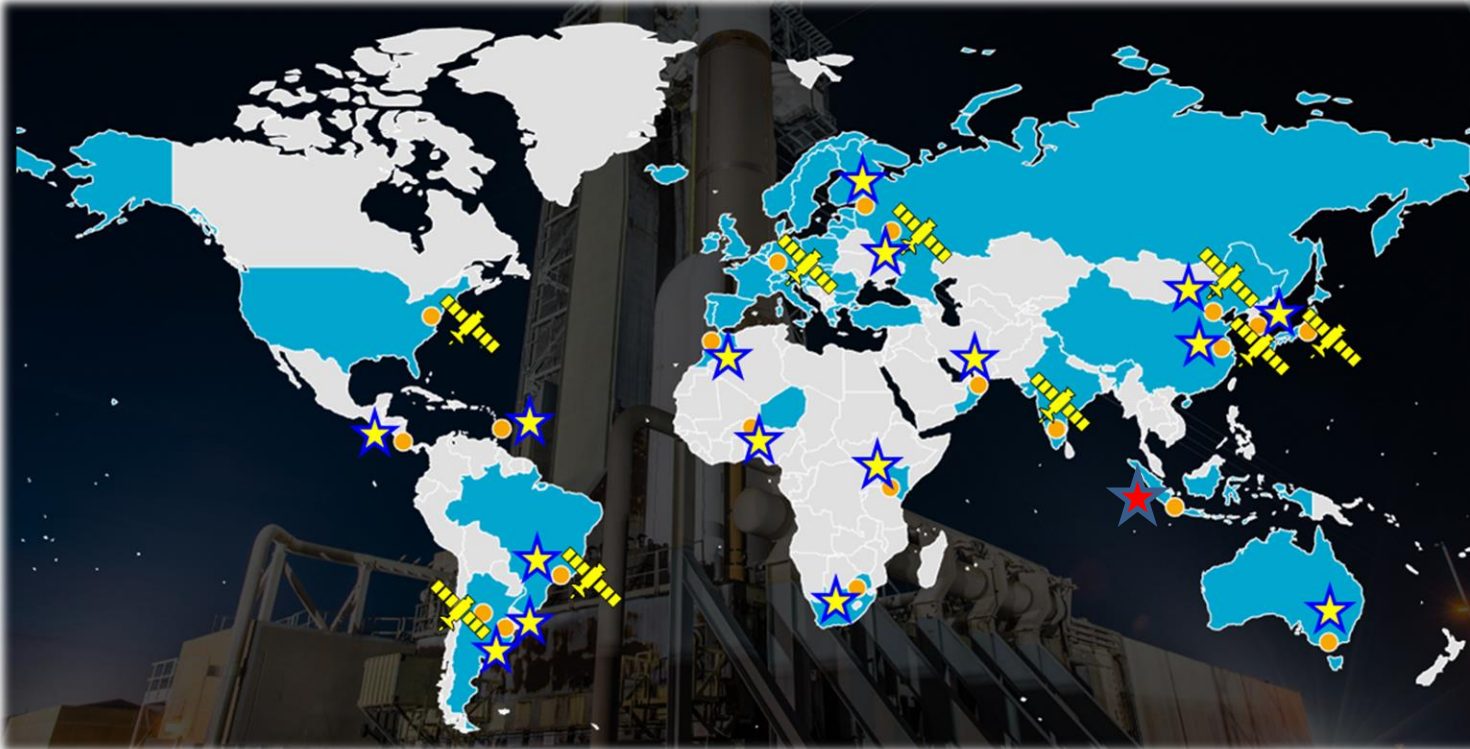
World Meteorological Organization  
Organisation météorologique mondiale

# WMO-CGMS Virtual Laboratory for Education and Training in Satellite Meteorology (VLab): Who are we and what do we do?

**Bernie Connell (CIRA, USA) and Wen Bo (CMA TC, China)**  
VLab Co-Chairs  
**Zoya Andreeva, WMO**  
**Marcial Garbanzo, UCR, Costa Rica (TSO)**



## WMO-CGMS VLab - established in 2000



The Virtual Laboratory for Training and Education in Satellite Meteorology (VLab)

### Satellite Agencies

CMA, CONAE, EUMETSAT, INPE, JMA, KMA, NOAA, ROSHYDROMET, IRSO

### Centres of Excellence

Costa Rica, Barbados, Brazil, Argentina, Morocco, Niger, Oman, Kenya, South Africa, Russian Federation, Republic of Korea, China, Australia



Candidate as a New Centre of Excellence : BMKG Indonesia

Coordination Group for Meteorological Satellites (CGMS)  
and World Meteorological Organization (WMO)



## Our Mission

*To improve weather, water, climate and environmental services by enabling WMO Members to utilize satellite data.*

### What we do:

We provide training that promotes the interdisciplinary application of satellite data for user services.

We share knowledge, experience, methods, and tools related to access and usage of satellite data, especially in support of WMO Members that have limited resources.

### Our audience:

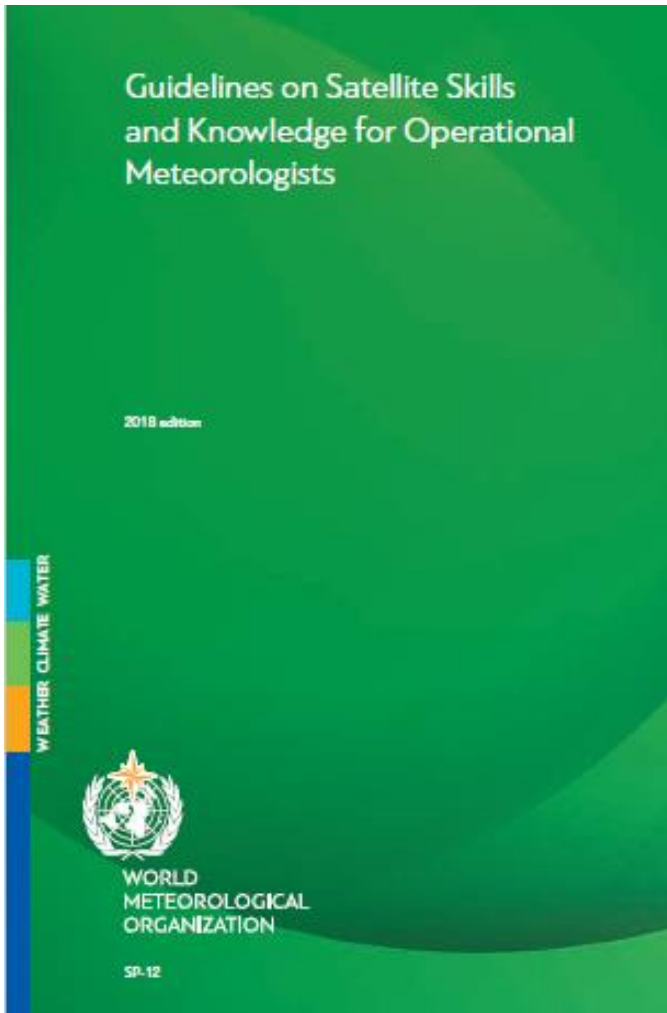
Mainly operational meteorologists: those performing the duties of analysis, diagnosis, prognosis and forecasting of the weather.

...and includes students, researchers, trainers, managers, and others spanning related disciplines that use weather and climate information

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and World Meteorological Organization (WMO)**



# Satellite Skills



VLab SATELLITE SKILLS AND KNOWLEDGE FOR OPERATIONAL METEOROLOGISTS			
LEVEL 1 - Skills	LEVEL 2 - Performance components	LEVEL 3 - Performance components detailed	Skills, techniques and knowledge requirements
1. Identify surface features	1.1. Identify words and geographical features.	1.1.1. Recognize basic land and water forms, hills, lakes, rivers, lakes, etc.	To be contextualized depending on the local circumstances 1.1. Application of broad knowledge, water vapor (WV), radiances, and microwave channels.
	1.2. Identify surface characteristics and conditions, including physical, chemical, biological, and other characteristics, and their effects on satellite observations.	1.2.1. Identify surface characteristics and conditions, including physical, chemical, biological, and other characteristics, and their effects on satellite observations.	
2. Identify cloud types and their characteristics	2.1. Identify cloud types and their characteristics.	2.1.1. Recognize cloud types and their characteristics.	2.1. Recognize cloud types and characteristics (CB, AL, ML, CU, CS, NI, etc.) 2.2. Application of broad knowledge, water vapor (WV), radiances, and microwave channels.
	2.2. Identify cloud types and their characteristics.	2.2.1. Recognize cloud types and their characteristics.	
3. Identify and interpret satellite data and products	3.1. Identify and interpret satellite data and products.	3.1.1. Recognize satellite data and products.	3.1. Recognize satellite data and products. 3.2. Application of broad knowledge, water vapor (WV), radiances, and microwave channels.
	3.2. Identify and interpret satellite data and products.	3.2.1. Recognize satellite data and products.	
4. Identify and interpret meteorological phenomena	4.1. Identify and interpret meteorological phenomena.	4.1.1. Recognize meteorological phenomena.	4.1. Recognize meteorological phenomena. 4.2. Application of broad knowledge, water vapor (WV), radiances, and microwave channels.
	4.2. Identify and interpret meteorological phenomena.	4.2.1. Recognize meteorological phenomena.	
5. Interpret defined fields and defined products	5.1. Interpret defined fields and defined products.	5.1.1. Interpret defined fields and defined products.	5.1. Interpret defined fields and defined products. 5.2. Application of broad knowledge, water vapor (WV), radiances, and microwave channels.
	5.2. Identify and interpret satellite data and products.	5.2.1. Recognize satellite data and products.	
6. Identify and interpret satellite data and products	6.1. Identify and interpret satellite data and products.	6.1.1. Recognize satellite data and products.	6.1. Recognize satellite data and products. 6.2. Application of broad knowledge, water vapor (WV), radiances, and microwave channels.
	6.2. Identify and interpret satellite data and products.	6.2.1. Recognize satellite data and products.	
7. Compare satellite data with conventional weather and climate data	7.1. Compare satellite data with conventional weather and climate data.	7.1.1. Compare satellite data with conventional weather and climate data.	7.1. Compare satellite data with conventional weather and climate data. 7.2. Application of broad knowledge, water vapor (WV), radiances, and microwave channels.
	7.2. Identify and interpret satellite data and products.	7.2.1. Recognize satellite data and products.	

Poster hung in Lab: Students are found checking the list to see what skills they need to improve.

- Recognition and inclusion of lightning measurements
- Review of additional skills:
- Skill 8: Apply satellite-based climate data records for Meteorological Services
- Skill 9: Apply satellite-based products for Agricultural monitoring

[https://library.wmo.int/index.php?lvl=notice\\_display&id=19843](https://library.wmo.int/index.php?lvl=notice_display&id=19843)

Coordination Group for Meteorological Satellites (CGMS) and World Meteorological Organization (WMO)



## How do we implement competency-based training?

### 1. Include Satellite Skills in the training plan

- Identify the skills that will be addressed
- State the skills in the course description
- Add the skills to the back of the certificates

### 2. Link the training to the existing WMO competency framework

- In Calendar announcements
- In the Library of training resources

#### *Challenge*

- Reaching wide adoption of the Satellite Skills in training.

#### *Solution tried*

- Awareness campaign.

#### *Reported Benefits*

- Skills helped Trainers to write clearer learning objectives;
- Skills helped professionals to identify gaps in their skill sets.

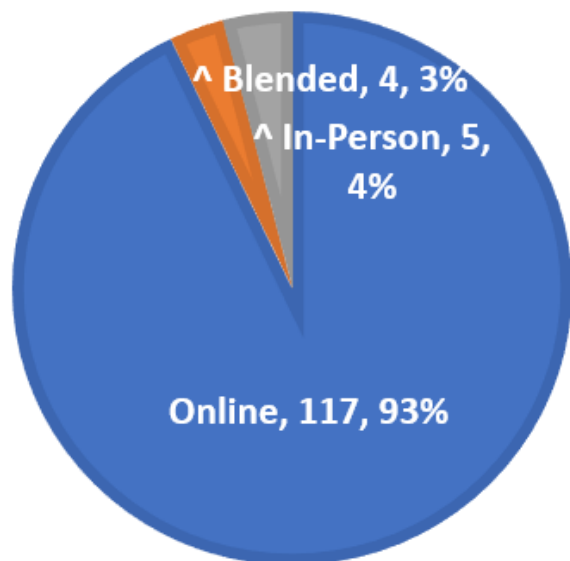
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and World Meteorological Organization (WMO)



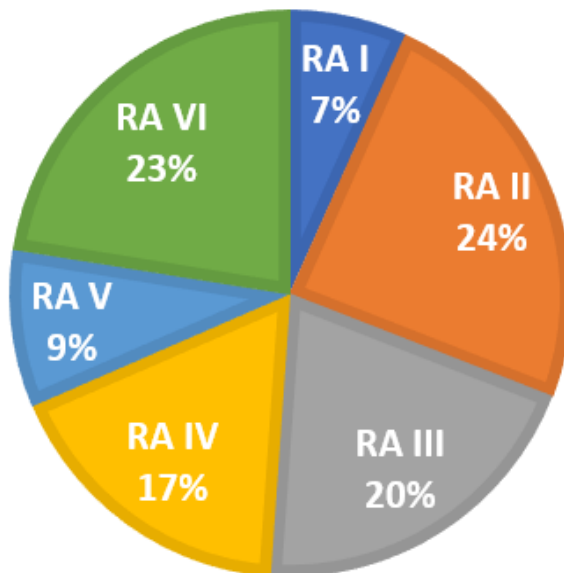
# Overview of Training: December 2020 through November 2021

- A total of **126** training events were organized by VLab partners in 2021.
- About **4,250 learners** participated from all WMO Regional Associations (RA).
- Training offered in 7 languages; some events were bilingual.

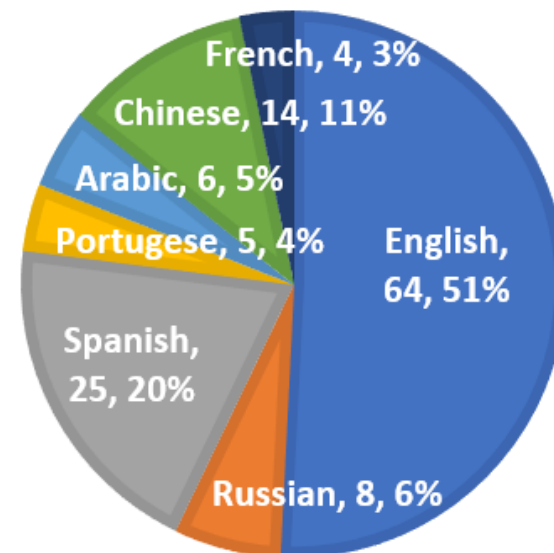
### TRAINING DELIVERY MODE



### TRAINING DISTRIBUTION



### TRAINING LANGUAGES



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# Continuous Professional Development

## 1. Promote initiatives

- CoE Courses
- Themed events
- Internships
- Regional Workshops
- Hackathons
- Regional Focus Groups

## 2. Train the Trainers and Gather Input and Feedback

- Offer regional training of trainers
- User Conferences & Surveys
- Adopt WMO Education & Training guidelines

## 3. Global Campus

Sharing of

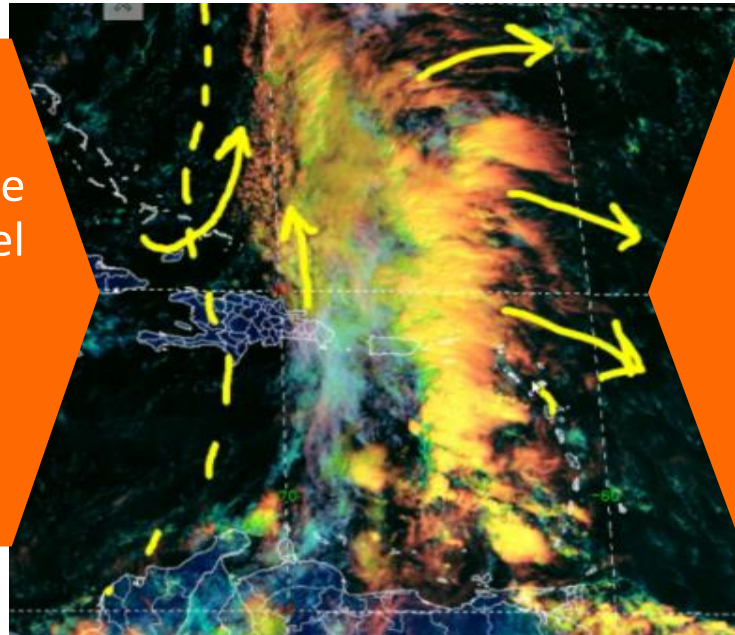
- Training materials
- Instructional innovations
- Assessment methods

### Challenges

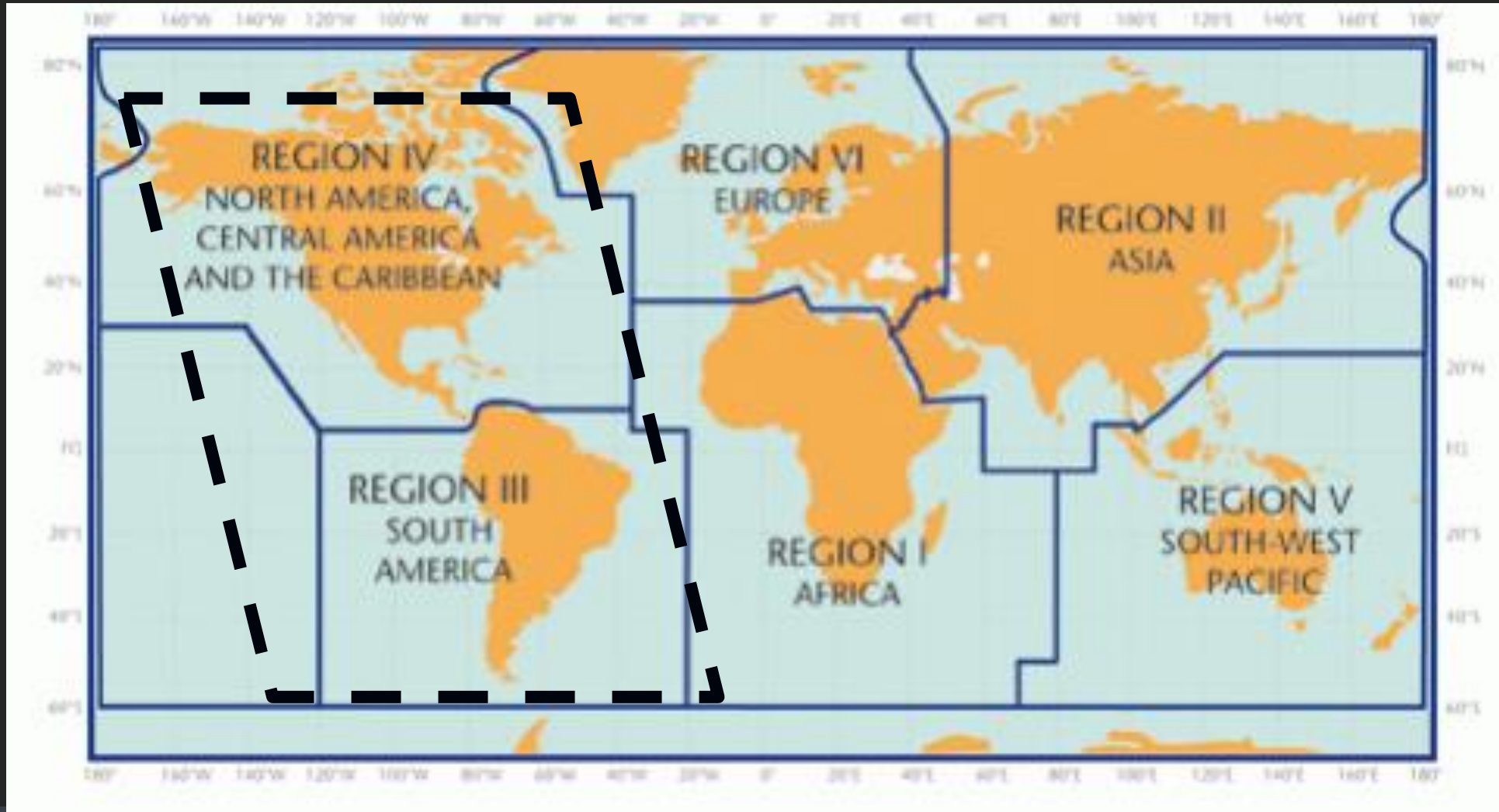
- Maintaining up to date knowledge and skills of operational personnel and trainers;
- Raising awareness of developments in satellite meteorology.

### Approaches

- Work closely with subject matter expertise;
- Foster communities of practice;
- Encourage sharing of training resources.



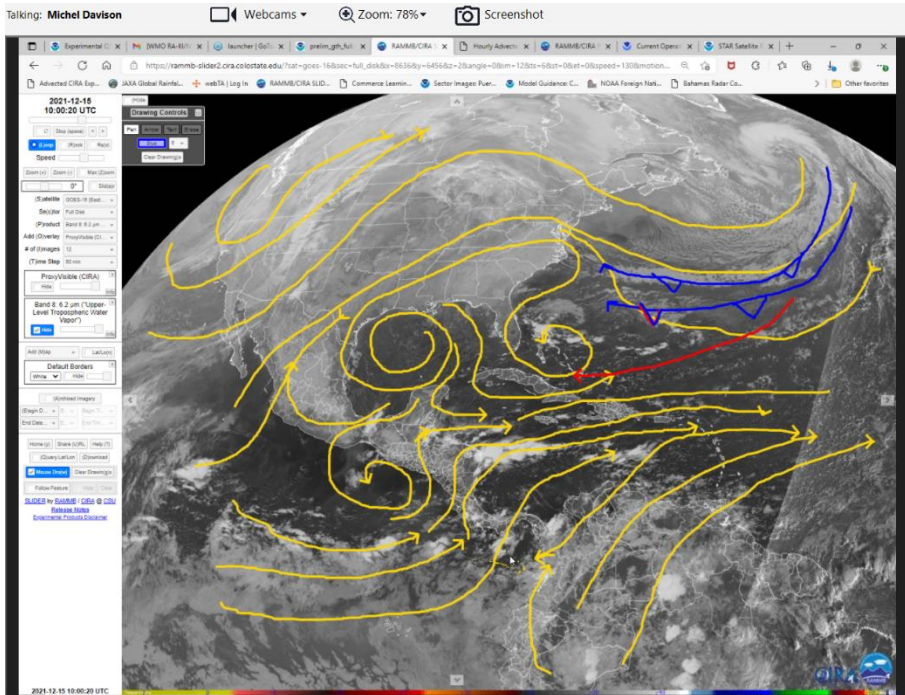
# WMO Regions





# What is a Focus Group?

- A long term Community of Practice that brings together diverse stakeholders
- Informal learning (no participation certificates are offered)

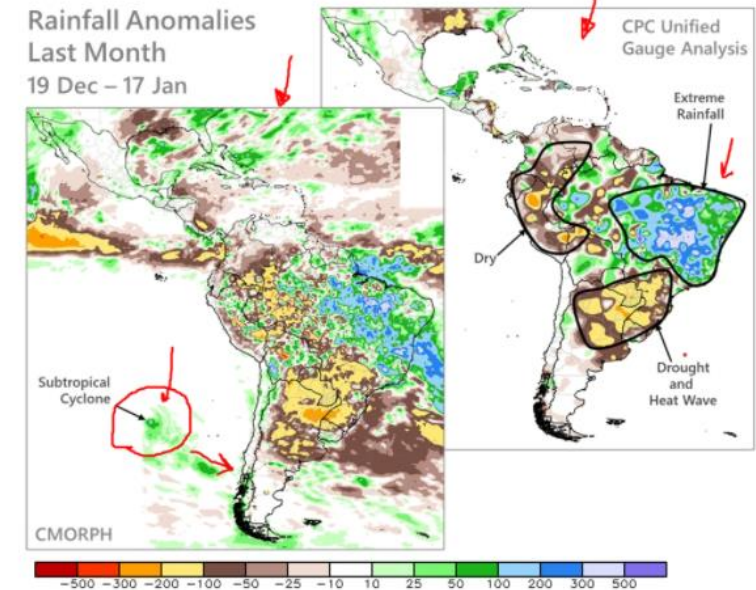


Synoptic Overview

Too many topics to address during this session:

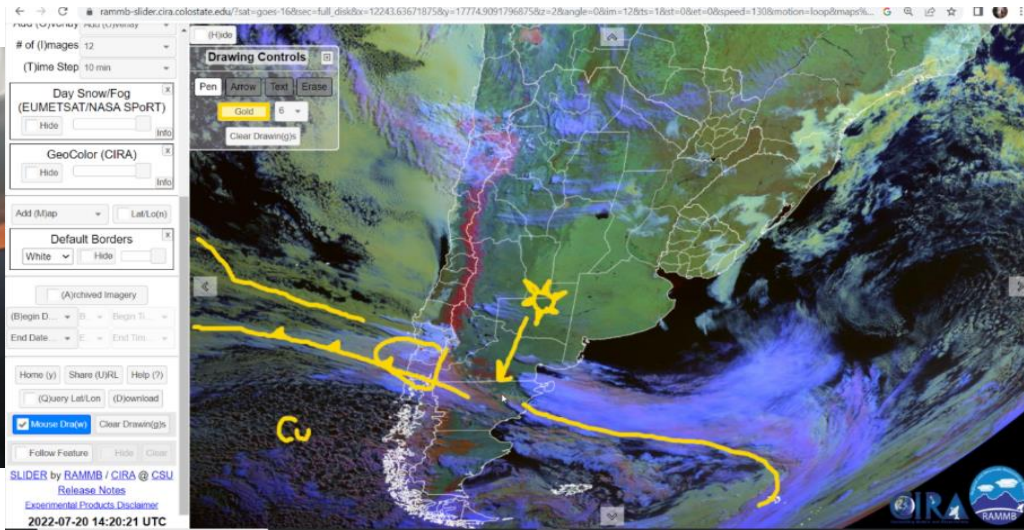
- Dec 30 Fires in Colorado ✓
- Dec 23 -Jan 11 Extreme Rainfall in Brasil, persistent SACZ events ✓
- Jan 10-17 Heat wave amid drought in the Parana/La Plata Basin ✓
- Jan 11-12 Subtropical Cyclone off the coast of Chile ✓
- Jan 15 Tonga Volcano Explosion ✓

Review of significant events over the past month



Climate Indices & Summaries

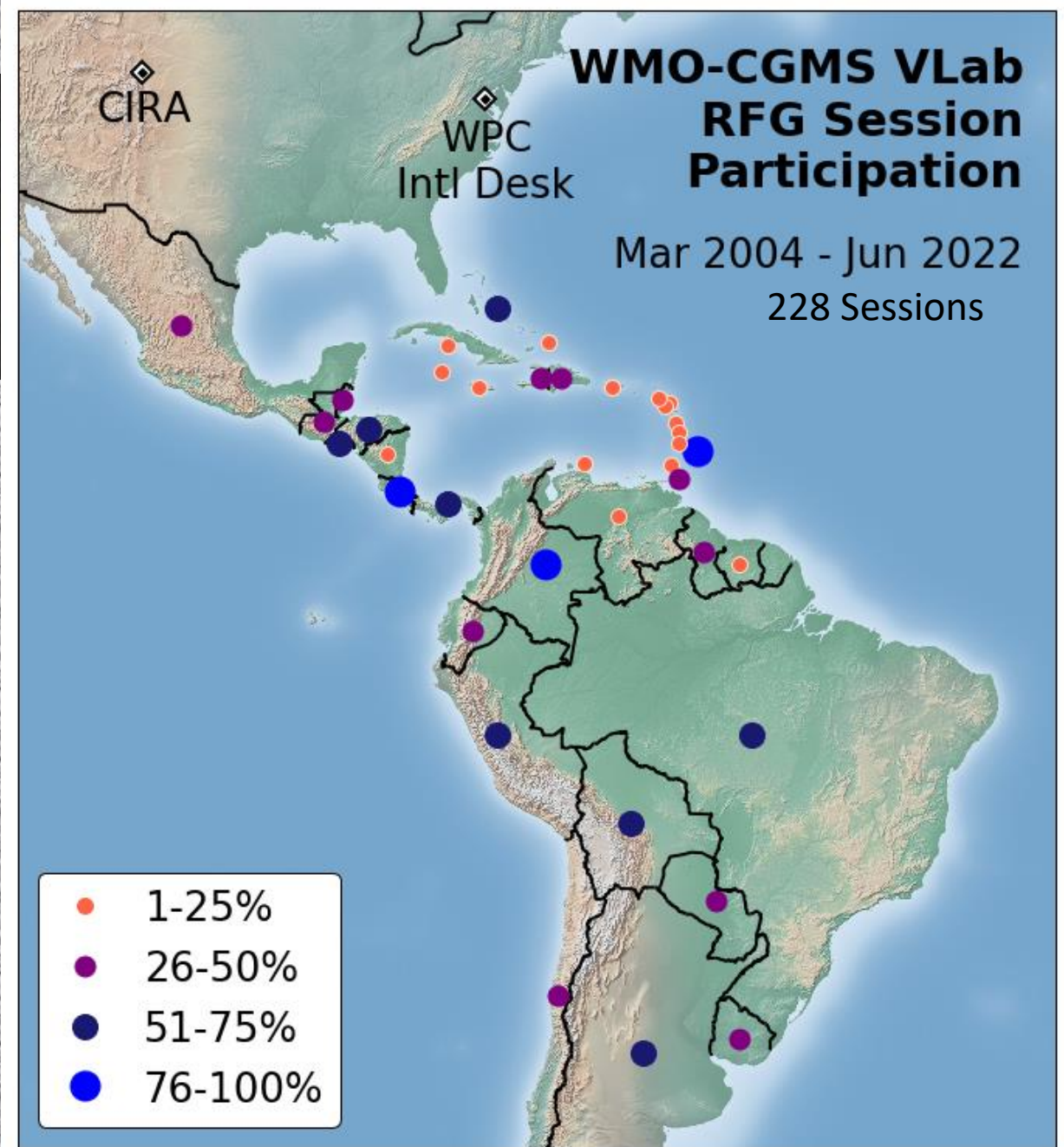
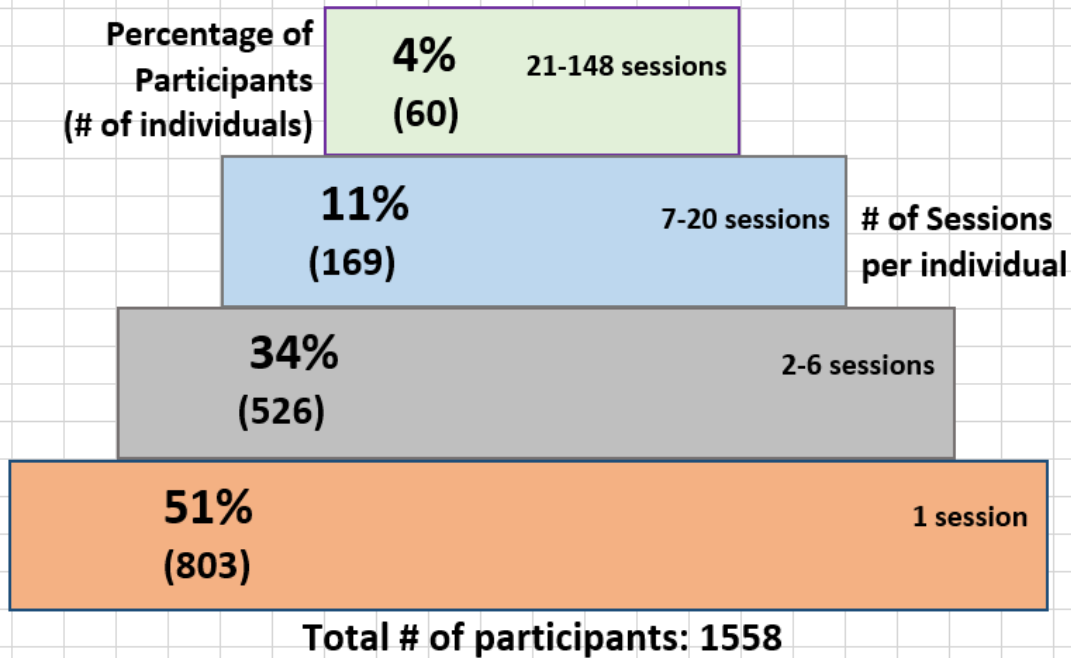
# Continued Engagement through Virtual Monthly Regional Focus Group Weather and Climate Discussions Example for the Americas and the Caribbean



<http://rammb.cira.colostate.edu/training/rmtc/focusgroup.asp>

# Building Capacity and Community

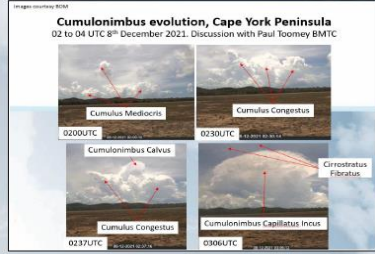
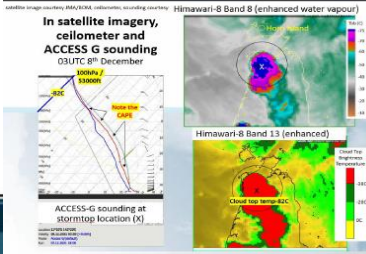
RFG session participation March 2004 - June 2022



# Other Monthly Regional Focus Groups Discussions

## ➤ Australian VLab CoE: October 2013 – 2022 >>> *9 years*

**3: Case studies of cloud types classified using surface as well as satellite images and image animations**



➤ Africa

➤ *Indonesia*

BMKG REGIONAL TRAINING CENTRE FOR RA V, INDONESIA

Designing the Indelible Moment of OGD#100: a celebration of the 100th Online Group Discussion

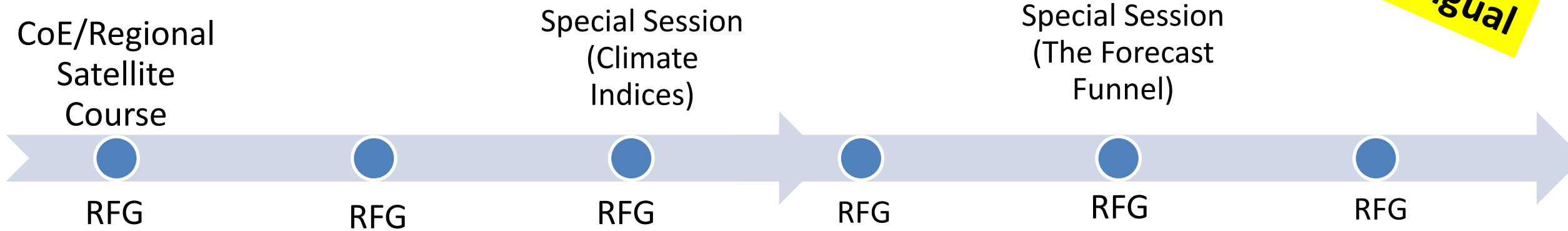
Australian VLab Centre of Excellence Regional Focus Group (RFG), August 13th 2020

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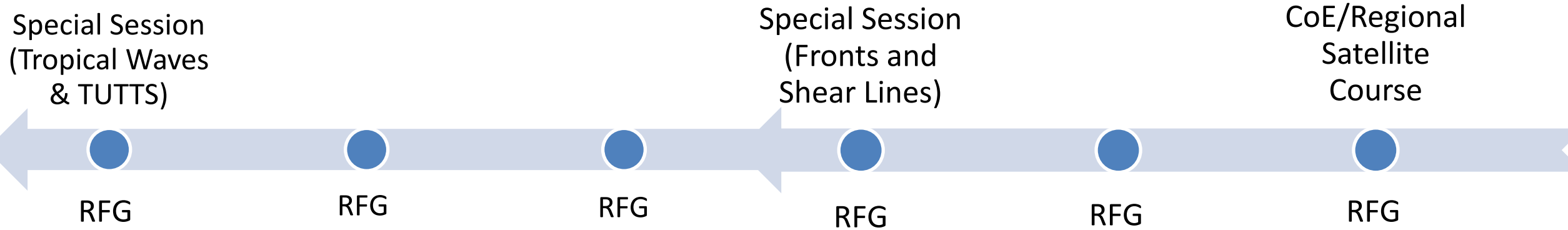


# Make the information stick with blended learning approaches

**bilingual**



Application, peer networking, mentoring, reference online materials...

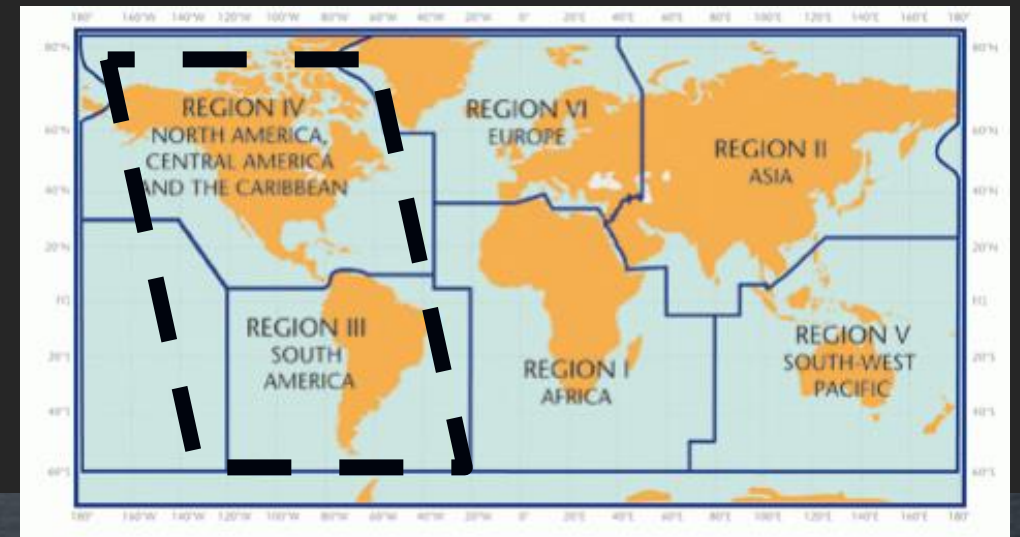


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# Collaborations = Successes

- Increased Country, Organizations, and Individual Participation = Community of Practice
- Colleagues and Previous Participants as Facilitators and Instructors of sessions.
- Students and early career professionals have moved into forecaster, instructor/trainer, researchers, manager, and senior professional roles.
- Promotion of:
  - Peer to peer interaction
  - Communication across boundaries
  - Continuing Professional Development
  - Interdisciplinary Linkages





## Collaborations for enhancing training

### Community for the **Advancement of Learning in Meteorology** *and* related disciplines

- The CALMet XIV Conference: “Bringing Together the Best of Online to Learning”
- Host: Servicio Meteorológico Nacional, Argentina (VLab CoE) **VIRTUAL!**
- 56 contributors from all Regional Associations of WMO.
- 260 educators, trainers and managers from universities, research institutions, and National Meteorological and Hydrological Service registered for the event.



<http://www.calmnet.org/>

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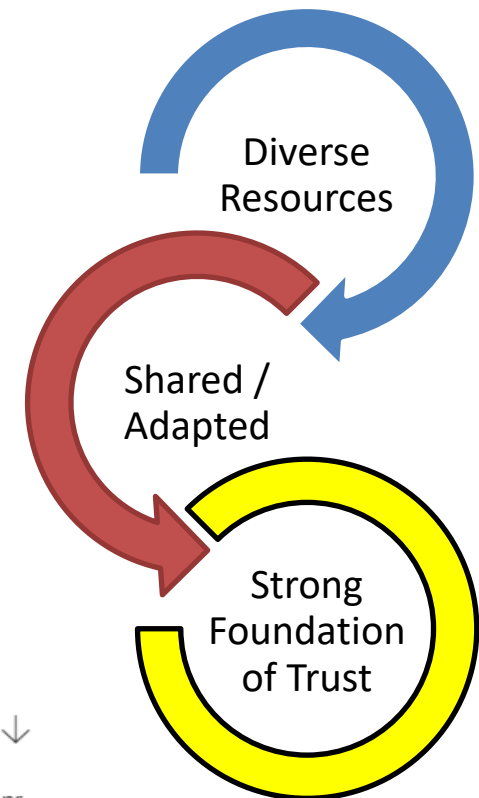


# WMO Education & Training Program and the Global Campus Initiative

- WMO Global Campus: Library of resources & Calendar
- WMO Capacity Development Strategy
  - Promote Impact based forecast messaging



2022				↑	↓
Jan	Feb	Mar	Apr		
May	Jun	Jul	Aug		
Sep	Oct	Nov	Dec		



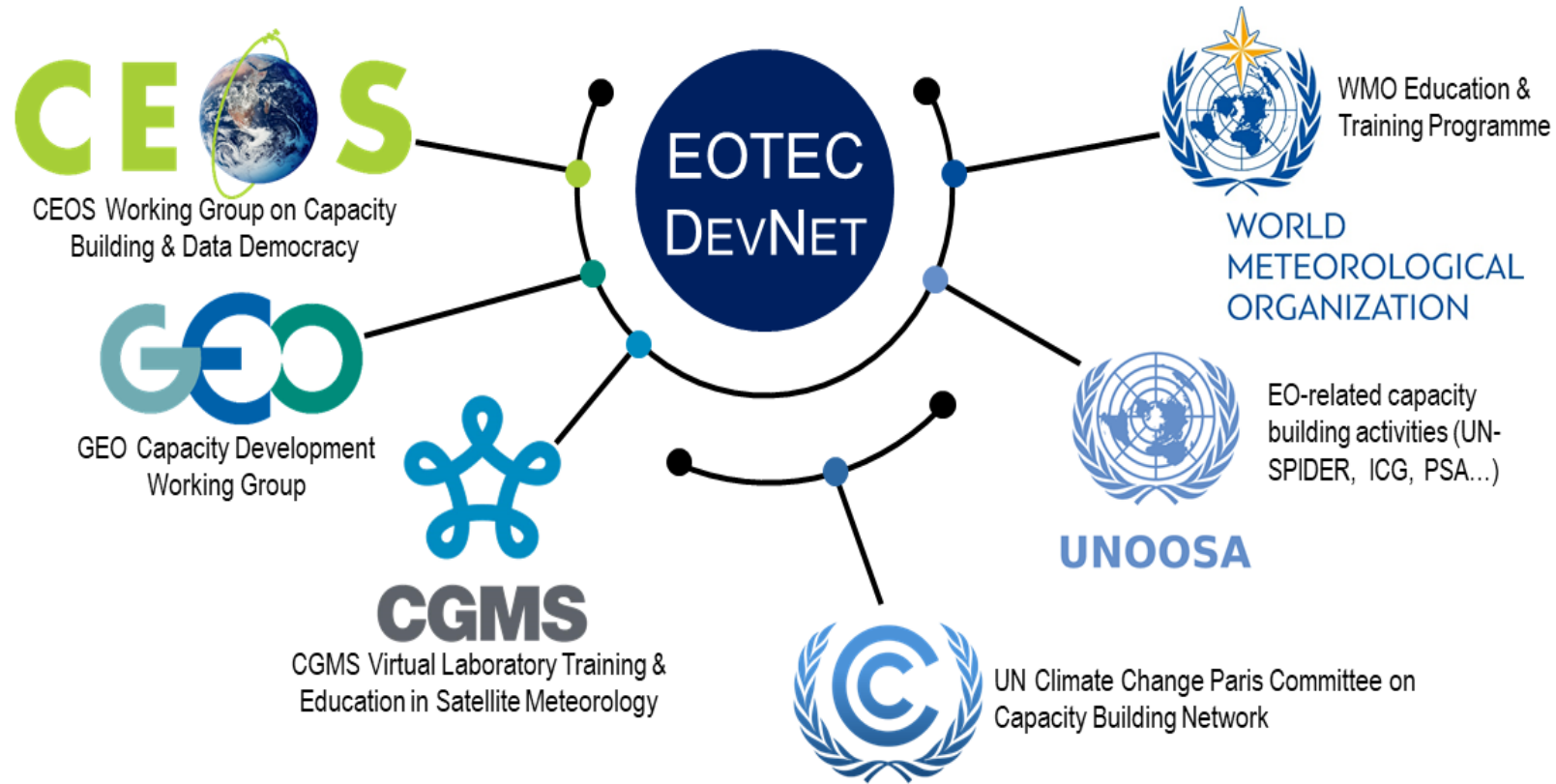
<https://community.wmo.int/calendars-and-resources>

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# We are finding our place among other Global Efforts

## The Committee on Earth Observation Satellites (CEOS) Earth Observation Training, Education, and Capacity Development Network



<https://ceos.org/ourwork/other-ceos-activities/eotec-devnet/>

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# Examples of small things that make a big difference to enhance engagement.

- Make sure the providers put color bars and units on products!
- Use level 0, 1, 2 etc. to describe product, not 'catchy' nicknames
- If you provide information, think simple language:
  - It is easier to understand and pass on to users.
  - It can be translated to other languages more readily.
- Provide reasonable information on Imagery/Product latency.
- Rain rate vs accumulation confusion.
- Join in a workshop or RFG session to see how they operate. If applicable, volunteer to present, particularly for languages other than English.

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# Thank You!

WMO-CGMS VLab <https://www.wmo-sat.info/vlab/>

CIRA/NOAA/VLab  
<https://rammb2.cira.colostate.edu/training/rmtc/>

Bernie Connell    [bernie.Connell@colostate.edu](mailto:bernie.Connell@colostate.edu)

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